THE Chemical Age

VOL. LXXI 18 SEPTEMBER 1954 No. 1836

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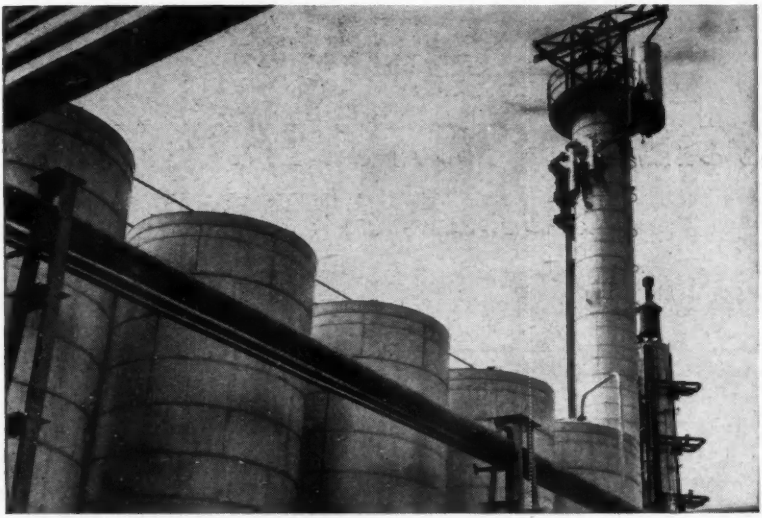

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Technical College Research

THE past few years have provided a good many reports and debates on technological colleges and their place in the national scientific pattern. A new report which concentrates upon facts rather than hopes—a study of applied research in London's 25 technical colleges*—is timely and valuable. It is always easy for progressively-inclined people to plan what should or could be done while ignoring or knowing little about what actually is achieved.

The report covers research in only 17 of the 25 technical colleges, for eight either did not provide the advisory council with information or made 'nil' returns, but it is a safe enough assumption that in this region all the applied research is being carried out at these 17 colleges—such well-known centres as the Battersea, Chelsea, Woolwich, and Regent Street Polytechnics, the Sir John Cass College, etc. At some 12 of the 17 colleges research carried out by staff and advanced students is regarded as normal; at other colleges, though there is some staff research, the participation of students is unusual. The deciding factor appears to be the amount of degree work done; where this is small, student research is negligible. Such an influence is to be expected, but it must not also exercise a negative effect upon staff research. Unless staff research is automatically associated with technical college teaching, people of the right type are unlikely to be attracted.

The most serious restriction upon research would seem to be accommodation; in some cases it is the sole restriction, in others it means refusing graduates' applications for research work. In one case a project for a research association had to be abandoned for lack of room to house the necessary equipment. On the whole, the buildings of London's technical colleges are far from new. The expansion of education has not unnaturally changed bold ventures of the past into present inadequacies. However, delays in post-war plans now seem in some cases to be fading and the advisory council is hopeful that there will be substantial improvements in accommodation during the next five years.

The type of research carried out—as revealed by a survey of all original papers published between 1947 and the end of 1952—has a bias towards chemistry and biology with a particular emphasis upon organic chemistry. This is probably a reflection of the accommodation problem, for often enough it is this type of research that requires the least space. Certainly, engineering research or applied chemical research will frequently call for large amounts of floor space and height. On the other hand, some of the engineering research that is conducted at the colleges is unlikely to achieve publication, not only because work is done in co-operation with firms but also because there are fewer journals to publish engineering research papers. To that extent, the assessment of total research effort by analysing published papers is not wholly accurate.

However, the bias towards organic

* Applied Research in Technical Colleges. Regional Advisory Council for Higher Technological Education, 1954. From the Secretary, Tavistock House South, Tavistock Square, London, W.C.1., 2s. 6d.

chemistry as the major research subject is open to criticism. Initiated by the accommodation difficulty and perhaps also by the greater ease with which organic work can be fitted into the congested time-tables of college staff, a development of expediency has probably acquired the features of habit and tradition. But 'relatively few of the published researches listed in organic chemistry appear to have been undertaken in direct co-operation with industry.'

It is somewhat paradoxical that technical colleges should show a trend towards pure research. Admittedly, general studies of our total national research effort in science have stressed the need for more pure or fundamental research, but it would seem preferable for this change in balance to be effected at the large university research centres and at specialised research stations. Technical colleges and technology should surely keep as close together as possible. The advisory council's view is not that the volume of fundamental research should be diminished but that the accompanying volume of research in consultation with industry should be increased.

The opportunity for joint work with industry is considered to be large, and mainly expressible through the research needs of small firms. Part-time students working for higher degrees might undertake this type of work; or firms themselves might even nominate an individual who would then be treated as a part-time student attached to the technical college. The former suggestion would seem to have its weaknesses unless a firm's problem was of fundamental rather than applied nature, a regrettable consequence of the old tendency for prejudice against 'non-pure' subjects as theses for academic awards. A wider academic attitude towards applied research would no doubt stimulate more technical college work of this kind.

There is still a need to stimulate the interest of local firms in technical college facilities. Publicity from the centre is called for so that industry can be informed of the research now proceeding; in this respect the present report on the London colleges contains a number of examples in its appendices, particularly at the Battersea Polytechnic. However, only seven of the 17 research-conducting colleges reported that requests for research had been received from industry, and that in the main such requests have been no more than occasional and very rarely from firms with less than 100 employees. This is a clear sign that the view that technical colleges could give research help to the small firms who most need it is still almost entirely theoretical.

The problem of the staff research worker's timetable is by no means simple. It is suggested that suitable members of staff should have their teaching programmes reduced by an extra hour or so per day enabling one clear day per week to be devoted to research, and that the time allocated to research might be increased in the cases of successful projects. But all this is qualified by the phrase 'subject to the teaching needs of the college!' Is the supply of teachers of chemistry and other sciences so adequate that teaching time-tables can in fact be so readily adjusted? The argument that more scientists would be prepared to teach if research rights and facilities were assured is again somewhat theoretical—it assumes there is a reservoir of qualified man-power unwilling to join technical college staffs only because research possibilities are too small. This may be questioned. In the past much of the research effort of teaching staff in technical colleges has been the tiring and valiant product of spare time.

Although its commentary is fairly short, the advisory council's report is a most useful survey of the facts. It should certainly provoke more constructive thought about the place of the technical colleges in the development of science. If indeed there are many difficulties, they can be gradually overcome if the will exists. It is perhaps as good a test as any of our real desire to expand technological research in Britain to see whether the older technical colleges can be themselves expanded in size and function.

Notes & Comments

Name Trouble

THE American Chemical Society autumn meeting has two hours scheduled in its timetable for an open discussion on the modern usage—or more accurately 'abusage'—of the word 'petrochemical.' It is still a youthful word when employed to describe chemical substances made from petroleum; it has acquired this meaning only in the past twelve years. Unfortunately, the word has a much older history in geology and petrology (rock science) and there it is used to describe chemical substances found in rocks. 'Petrochemistry' is a well-established word covering the chemical study of rock-occurring substances, having been commonly used as a basic technical word for over 40 years. Now, however, the expansion of the chemicals-from-oil industry has become so big that the newer use of 'petrochemical' is becoming far more frequent, both in and out of genuinely technical literature. Is it too late to discourage the word now? Geologists and petrologists certainly have an ample case—an important technical word specifically their own has been pirated without any thought. Etymological and longer-usage evidence is on their side. But with words usage, even more than possession with goods, is generally nine points of the law.

Factory & Farm

PROFESSOR Austin Robinson's presidential address to the BA economics section has been received as over-pessimistic. The core of his case is that our national economy is still based upon the industrial leadership we possessed in the last century and that this is a leadership we can no longer enjoy. Other countries have created similar or closely similar conditions for successful industrialism and in the long run we shall be forced to change the agriculture/industry balance that has been the bedrock of our peacetime economy since 1870. Professor Robinson expressed the fear that such changes may one day become necessary more urgently 'than a free and smoothly working economy can easily carry them out.' To some extent this view of the future is a national and economic form of Malthusianism, but like Malthusianism it must be countered with solid evidence if it is to be fairly dismissed as gloomy improbability. The application of science to agriculture, in accomplished fact and even more in potential possibilities, is the only answer that enables the Malthus thesis to be dismissed. Are there similar possibilities that will enable us to continue exporting enough goods to maintain an expanding industrialism side by side with a limited agriculture? The application of science to industry is no solution, for its influence is equally available both in countries competing with us for export trade and in countries to whom we export.

Money & Men

AN article in *The Economist* (1954, **172**, 715) puts forward the answer that our exporting future must be based more and more upon goods which require high capital investment for their production and which also make a high call upon labour. The first condition will enable us to compete successfully with countries like Japan, the second with the United States. The rate of capital investment in the newer industries will probably determine whether this export pattern can actually develop. If this view is correct, the chemical industry will have a somewhat lesser importance than modern engineering industries. Chemical production needs a high rate of capital investment, but it usually has a particularly small labour cost. The production of modern machinery has both high capital need and relatively high labour cost. However, this disability of proportionately low labour needs, which reduces America's disadvantage of high labour costs, has not hitherto prevented the British chemical industry from making a major contribution to our export trade. So long as we develop new chemical products without delay we can sell them without excessive competition from other producers.

Rain Stopped Play

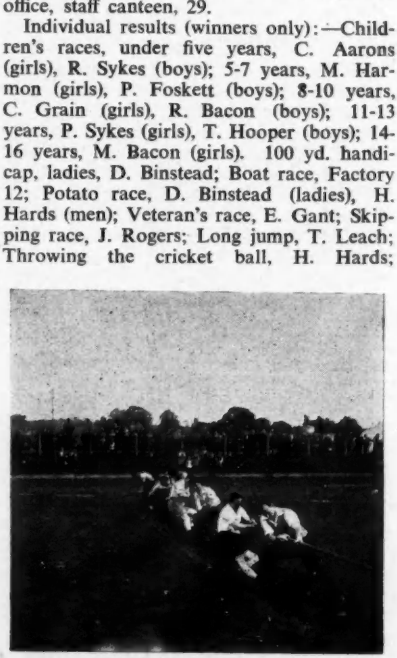
Kemball Bishop's Annual Sports

RAIN, thunder and lightning spoiled the early part of Kemball, Bishop & Co. Ltd.'s sixth annual sports at the Ashton playing fields, Woodford Bridge, on 11 September. Competitors and spectators huddled in the refreshment marquee, and at one time it looked as if the meeting would have to be called off.

Later, the sun came out and all the planned events were carried through slightly behind schedule. About 800 people—employees and their guests—attended, and prizes were presented at the end of the afternoon by Mrs. F. H. Kemball, wife of Col. H. F. Kemball, T.D., D.L., managing director.

The inter-divisional challenge shield was won by Factory 12, who got 48 points. Runners-up were: Research laboratory, works and general laboratories, 45; general office, staff canteen, 29.

Individual results (winners only):—Children's races, under five years, C. Aarons (girls), R. Sykes (boys); 5-7 years, M. Harmon (girls), P. Foskett (boys); 8-10 years, C. Grain (girls), R. Bacon (boys); 11-13 years, P. Sykes (girls), T. Hooper (boys); 14-16 years, M. Bacon (girls). 100 yd. handicap, ladies, D. Binstead; Boat race, Factory 12; Potato race, D. Binstead (ladies), H. Hards (men); Veteran's race, E. Gant; Skipping race, J. Rogers; Long jump, T. Leach; Throwing the cricket ball, H. Hards; Fashion parade, D. Binstead and L. M. Miall; 100 yd., men, R. Tangui; Wheelbarrow race, D. Binstead and J. Elkin; Three-legged race, D. Binstead and J. Elkin; 100 yd. handicap, men, R. Tangui; Tug-of-war, Factory 12; Obstacle race, G. Harmon; 220 yd., R. Tangui; Sack race, D. Binstead (ladies), M. Diss (men); Slow bicycle race, R. Trew; Novelty race, R. Hall; 440 yd. relay, Factory 12.



The winning team, from Factory 12, in the tug-of war final

Visits to Steel Works

A TOTAL of 48 university lecturers, representing most of the universities in the country, were the guests of the United Steel Companies Ltd. at a conference in Sheffield last week. The conference opened on 6 September. Its aim was to give an insight into production methods and problems in iron and steel making and shaping, some characteristic problems in research, and the way in which a steel company is staffed and administered.

During their stay, which lasted until 10 September, the lecturers visited various branches of the United Steel Companies, including steel works and the Central Research & Development Department at Rotherham, and the research laboratories of the British Iron & Steel Research Association at Sheffield.

A similar course was held the previous week for masters of public schools.

US Fluorspar Inquiry

AN investigation of the domestic fluorspar industry has been instituted by the United States Tariff Commission, and public hearings are to begin in Washington on 19 October. Interested parties who wish to appear and be heard at the hearings should notify the Secretary of the Commission (8th and East Streets, N.W., Washington, D.C.) in writing in advance.

A resolution adopted by the Committee on Finance of the United States Senate directs the Commission to include in its report the facts determined relative to production, trade imports and consumption of fluorspar in the United States. The report is also to include a statement of findings as to the effect on the competitive position of the domestic fluorspar industry of the present tariff status of imported fluorpsar.

New Ideas in Chemistry—II*

Sir John Lennard-Jones' Address Continued

IN actual molecules there are three main factors determining structure, viz. (i) the exclusion principle, (ii) the field of the atomic nuclei on each other and on the electrons, and (iii) the forces of the electrons on each other. In methane, for example, the electrons are attracted to the central carbon nucleus and to the hydrogen nuclei; also the hydrogen nuclei repel one another. Under their own forces alone the hydrogen nuclei would tend to take up a tetrahedral arrangement. The electrons may be regarded as already suitably disposed to receive them and to provide the maximum attraction when the nuclei are most deeply embedded in the electron cloud. In such a system the exclusion principle, the repulsion between the electrons and the repulsion between the nuclei all act in unison to produce the same effect. Whereas in the neon-like structure there is little correlation between the sets of electrons of different spins, in methane both sets are attracted by the hydrogen nuclei, and the two tetrahedra tend to be drawn into coincidence. Thus the eight electrons may be regarded as arranged in pairs in a tetrahedral manner relative to each other but constantly interchanging their positions. This is the interpretation to be given to localised bonds.

The structures of molecules such as ammonia, water and hydrogen fluoride are closely related to that of methane. In each there is an octet of electrons. In ammonia the two tetrahedral distributions of electrons are held by the three hydrogen atoms. Relative to the three NH 'bonds' there is a 'lone pair' projecting out at approximately a tetrahedral angle to them. Fig. 3 gives some indication of the reason for this. The angles between the bonds and the lone pair differ from tetrahedral ones only because of the forces between the nuclei and the electrons near them.

Similarly the water molecule may be pictured as having two pairs of electrons projecting out in directions nearly at tetrahedral angles to the two OH bonds, and the HF molecule as having three lone pairs of electrons projecting out behind the HF bond. Fig. 3 again may be used to illustrate this, the diagram showing equally well the most probable distribution of three electrons of the same spin when the position of the fourth is given.

The great significance to chemistry of these distributions of lone pairs is that they provide electron-rich regions and so are particularly reactive to electrophilic agents. The type of attraction between molecules or groups of molecules known as the hydrogen 'bridge' may be attributed to the interaction of a positive centre and an electron-rich distribution. These regions also contribute substantially to the electric moments of the molecules and thus have a major effect on their physical properties. Thus the characteristic behaviour of these and similar molecules may to a major extent be traced back ultimately to the operation of the exclusion principle.

Were it not for the exclusion principle

* The remainder of the Section B (Chemistry) presidential address delivered on 2 September at the British Association meeting at Oxford. Continued from last week's issue.

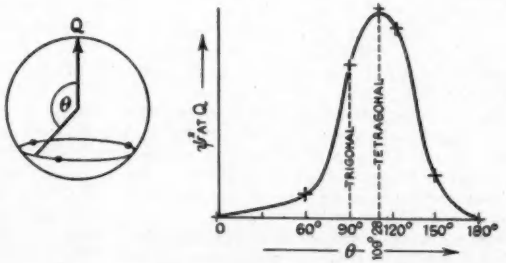


Fig. 3.—The distribution of a particle relative to three others on a spherical surface

all the electrons would crowd into the orbital of lowest energy and this would mean that they would tend to be near the nuclei or in those regions between them where the field is strongest. But the exclusion principle forces electrons into parts of space where they are remote from some of the nuclei. Thus in the molecule of carbon monoxide it is found that the ten outer electrons are to be assigned to five orbitals, of which only one gives a concentration of electron density between the nuclei. In one of the others the region of greatest concentration is near the oxygen nuclei on the side remote from the carbon atom. This is shown in Fig. 4. The contours show where the orbital has the same value.

In another orbital there is a similar distribution near the carbon nucleus on the side remote from the oxygen atom. These latter distributions each make large contributions to the electric moment of the molecule but they are in opposite directions and nearly cancel out. Though carbon monoxide has a small overall electric moment, there are asymmetries of charge distribution within the molecule which have chemical significance.

CONJUGATED MOLECULES

One of the most interesting and profitable applications of the new ideas has been to the structure of conjugated molecules. The nuclei of a conjugated system as a rule lie in a plane. The orbitals occupied by electrons in such a molecule can be divided into two distinct types. In the one the orbital distribution is symmetrical about the nuclear plane; in the other it is antisymmetrical—that is, the value to be associated with the orbital at corresponding points above and below the plane is the same in magnitude but opposite in sign. It follows that in the latter case the orbital has a zero value at all points in the nuclear plane. It is said to have a nodal plane.

In the language of chemistry the electrons in the single bonds of a conjugated system belong to the symmetrical type, the electrons taking part in conjugation to the other. The former are called σ-electrons, the latter π-electrons. Carbon atoms each provide one electron of the π-type, nitrogen and oxygen atoms sometimes one, sometimes two, according to the other atoms combined with them.

It is a consequence of these different symmetry properties that the π-electrons can for many purposes be dealt with separately. The four π-electrons of butadiene can be dealt with theoretically very much like the four particles in a one-dimensional box, given above. In the normal state of the molecule the electrons consist of two pairs of opposite spin, these being assigned to the two lowest orbitals of π-symmetry. These orbitals have properties along the chain somewhat similar to the sine curves of the model; in particular, electrons of the same spin tend to avoid each other.

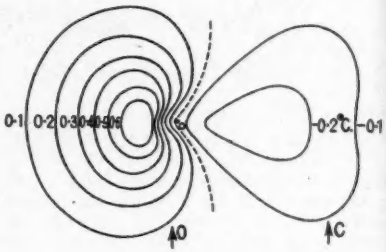


Fig. 4.—An electron distribution in carbon monoxide showing a concentration of charge outside the nuclei

The difference between the model and the molecule lies in the kind of field in which the electrons move. In the molecule the carbon nuclei attract the π-electrons and the saturated electrons repel them. The net effect is that the π-electrons move in a field which changes periodically along the molecule, but they are in fact trapped in a box-like domain. The fluctuations in the field along the box do not alter fundamentally the wave representations of the electrons. There are thus three main factors at work in determining the most probable configuration of the four π-electrons: (1) the nuclei, which attract the electrons, (2) the exclusion principle, which tends to keep electrons of the same spin apart, and (3) the mutual repulsion between electrons whatever their spin.

The attractive field of the carbon atoms will tend to keep one electron near each of them on the average, but the exclusion principle influences the arrangement of spins. If, as has now become usual, spins of one kind be denoted by the simbol α, and those of the opposite kind by β, the combined effect will be to render the arrangement α, β, α, β, and β, α, β, α, more probable than those of the type α, β, β, α, with two neighbouring

spins. It may happen that two electrons are simultaneously near one carbon atom, provided the spins are opposite. Such an arrangement might be written $\alpha\beta$, —, α, β with others of a similar kind. This would correspond to what is usually called 'an ionic structure.' The mutual repulsion of the electrons will, however, reduce the probability of these configurations.

These general features have been confirmed by detailed calculations of the electronic structure of butadiene. Thus, if an electron of given spin is assumed to be at a fixed position near one of the terminal carbon atoms, say C_1, then the probability of finding another of the same spin near the same atom is very small, the probability rises to a maximum on carbon atom C_2 and has a smaller probability of being at the other two. On the other hand, the probability of finding an electron of opposite spin has maxima at the second and fourth carbon atoms, C_2 and C_4.

This view of the inner structure of the molecule permits some insight into the processes at work in producing the property of alternating polarity. Suppose that under the influence of a reacting agent of an electrophilic kind the attractive field at a terminal atom is increased. There will then be a tendency of other π-electrons to move towards it; and the α and β electron systems may behave differently. Thus if the sequence of spins is α, β, α, β, then the β-electron from the second carbon atom can move towards the first under the influence of the field without conflicting with the exclusion principle. The β-electron on the fourth atom can do likewise, but the α-electron on the third carbon is held off. Thus we can regard the α-system as coupled together and the β-system as coupled together, but with only loose coupling between the two sets due to electrostatic forces.

The process of shift of π-electrons in electric fields is illustrated by Fig. 5, which shows the distribution of π-electrons in carbon monoxide. The contours show equal values of the orbital, rising to a maximum value above and below the oxygen nucleus. It is probable that there is a similar shift in conjugated systems wherever the —C=O group occurs. This permits a corresponding shift of all electrons, of the same spin on alternate atoms.

A similar picture of the unsaturated electrons in benzene can be drawn on the basis of the model of six electrons moving in a ring, considered earlier. The property of two sets of three electrons of the same spin, each coupled in trigonal symmetry within itself, but moving independently of each other, is modified by the electrostatic fields of nuclei and electrons. These fields will tend to produce an arrangement of alternating spins round the ring and there are two ways in which this can happen. As in the case of butadiene, an increase of attractive field at any one atom, whether the electron spin be α or β, will tend to cause a shift towards it of the set of electrons of the other kind of spin, that is of the electrons in the ortho and para positions. These positions will thus tend to become reactivated. If, on the other hand, the electron at one carbon is repelled by the field of another group, then the set of which it is a member will move away and cause enrichment at ortho and para positions relative to the meta positions.

THE ELUSIVE ELECTRON—TWO POINTS OF VIEW

It is not to be assumed that such a picture of benzene, or of butadiene, is sufficient to understand fully how the molecule will behave in all conditions. The properties of electrons in molecules are too elusive for that. We cannot say with certainty that an electron is here or is there. The electron density in a particular part of a molecule may on the average add up to one unit, indicating a charge equal to that of one electron, but the charge density in that

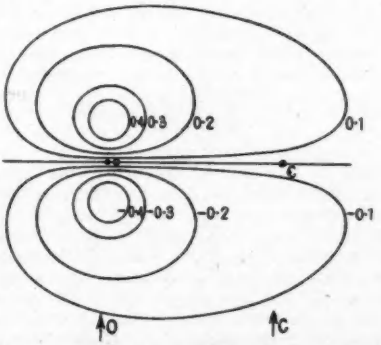


Fig. 5.—The distribution in a π-orbital in carbon monoxide

region is made of many parts, as though the electron were playing many rôles at the same time.

Two analogies may illustrate the dual behaviour of electrons. In some forms of dance, as in Scotch reels and square dances, there are four partners and for most of the time the dancers are to be seen in pairs at corners of the square performing some kind of figure. But there is constant interchange of partners and the identity of the pairs at any particular position does not remain the same. If any one dancer were to fall out, the gap created in the movement would appear at one corner of a square, then at each of the others in turn. The 'hole' thus left might be regarded as equally divided between the four corners of the square and thus to affect the whole equally. The removal of an electron from a molecule may similarly be looked upon as leaving a 'hole' in the whole system.

We might also compare a molecule with a layer cake. There are two ways of dividing up the cake. It can be taken apart layer by layer, each with its own characteristic flavour. Or it can be cut into segment portions in the normal way. Either method could at each stage give the same fraction of the whole. Electrons removed from a molecule by the absorption of light leave according to the layer method. Those removed by the chemist in a reaction are usually drawn as from a segment portion. But there is one important respect in which the analogy fails. When a portion of a cake is removed, the rest remains as it was. In a molecule this is not so. When an electron is removed by taking away an atom or part of the framework, the rest of the molecule adjusts itself to a new set of layer patterns. These patterns are the molecular orbitals appropriate to the new framework.

BUTADIENE & BENZENE RECONSIDERED

These properties of electrons may be illustrated by one or two examples. We have already discussed the structures of butadiene and benzene from one point of view. It is instructive to consider them from another. If one of the π-electrons in butadiene could be trapped by some means, say the one on carbon C_1, the other three would distribute themselves among carbons C_2, C_3 and C_4 as though they formed an allyl radical. They would occupy the two orbitals, lowest in the energy scale, with two in the lower one and one in the upper. The upper one, like the upper one in the box model considered earlier, has a node at the centre; that is, the electron in it avoids the centre atom (C_3). Let us next suppose that the trapped electron of butadiene is released and is then strongly repelled along the chain by some nucleophilic agent. In the limiting case when it is forced on to the allyl-like residue, the exclusion principle obliges it to occupy the upper orbital, that is to divide itself equally between carbon atoms 2 and 4. These would then become reactive to electrophilic agents.

In a similar way an electron on a carbon atom in benzene, say on C_1, if forced by some external agency on to the rest of the molecule, would be obliged to take up an orbital belonging to the pentadienyl residue. A simple, but approximate, calculation of the orbitals of this residue leads to the result that the one which is available, and lowest in the energy scale, has zero values on atoms C_3 and C_5, the meta positions. An electron in this orbital divides itself equally between atoms C_2, C_4, and C_6, the ortho and para positions. While this state of affairs represents an extreme case, it illustrates the tendency of the benzene nucleus to become activated preferentially at the ortho and para positions when an electron is repelled from one carbon atom into the rest of the ring.

The effect of taking electrons out of the ring can be illustrated by considering what happens when the CH_2^+ group is attached to form the benzyl ion. A simple orbital treatment shows that the six electrons redistribute themselves among the seven centres in such a way that the ortho and para positions are deactivated, the meta positions to a first approximation being unchanged.

THE PRESENT & THE FUTURE

It has not been the purpose of this address to detail the methods of calculation which have been developed to deal with molecular structure but rather to discuss their physical content. An understanding of the physical ideas involved may help the experimenter to appreciate the processes at work in determining the way chemical reactions take place and the theorist to see the significance of the difficulties which arise in his calculations. There has been remarkable progress in the application of the wave theory to the

[continued on page 574

India Plans Greater Cement Output

Problems of High Cost & Uneconomic Factories

CEMENT production in India will, it is estimated, reach nearly 5,000,000 tons a year by 1955-56 under the country's five-year plan for industrial development. This compares with 3,290,000 tons in 1951-52. The demand for cement is expected to increase considerably in the near future because of construction of multi-purpose projects, new buildings and roads.

The cement industry grew up in India in the years between the wars, and its rated capacity has increased rapidly in the last few years. Actual production, however, has been below capacity; in 1951-52, for example, the rated capacity was 3,880,000 tons.

By far the largest of the producing groups is the Associated Cement Companies which in 1950-51 employed 27,000 of the industry's 33,000 workers. The Dalmia group employed 2,000, and all the other units together accounted for 4,000.

Imports before the war were small. In the immediate post-war years they rose to some extent, but, with increased production since 1950, they again dropped. During the war India exported some cement, but greater demand since has cut down exports, except in very limited quantities. With the growing increase in capacity, it might be possible to export 200,000 to 300,000 tons or more by 1955-56.

Growth in Demand Gradual

The annual consumption of cement was 600,000 to 700,000 tons during the years 1929 to 1934, when owing to the general economic depression there was little constructional activity. Gradually the demand increased, and during the war years, as government expenditure on houses, roads, aerodromes and factory buildings went up, the consumption of cement also increased to 2,000,000 tons a year. During the post-war years it increased still more. The figures of the total cement supplied to different areas in India during 1951 and the first half of 1952 amounted to 3,170,000 and 1,714,000 tons respectively.

The sharp increase during recent years, when the war demand had disappeared, may be partly due to pent-up civilian requirements and the housing of displaced people. However, it may be that consumption in the last few years represents only the essential demand, and there is still a good deal of non-essential demand to be taken into account in assessing future requirements.

This demand, it is estimated, will reach 4,500,000 tons by 1955-56. This includes 600,000 tons for multi-purpose projects and 100,000 for roads.

Some Factories Uneconomic

The main problems the industry has to face are the uneconomic character of some of the present factories, the high costs of production and distribution and the rationalisation of marketing arrangements. At present, eight of the 23 factories have an annual capacity of less than 100,000 tons, which is considered uneconomic. Two of them, however, are expected to raise their capacity over this figure within the next five years.

The high costs are caused by a number of factors. Easily accessible supplies of limestone are being rapidly exhausted and, in some cases, factories have to transport it over long distances. State governments have not always co-operated in giving the industry leases of limestone of suitable quality. Until recently, the high price of jute bags meant that packing charges added appreciably to the cost. Machinery has had to be imported because the industry for making it in India has not yet been fully developed. Wide fluctuations in the price of fuel oil have prevented factories otherwise suitably situated from using it.

In 1946 an expansion programme drawn up by the government set a target of about 6,200,000 tons to be reached in five years. Later, when the country was partitioned and the tempo of development slackened, the programme had to be modified. Under the present plan, the rated capacity is to go up to 5,000,000 tons by 1955-56. This is to be achieved by expanding existing factories and building new ones, bringing the total number of units up to 27. The cement factory at Sindri, which it is hoped to complete in the second half of next year, would make use of calcium carbonate sludge obtained as a by-product from the fertiliser factory.

Factory Nuisance Criticised

ELLESMERE Port Council, at its meeting on 31 August, decided to defer consideration of an application by Cabot Carbon Limited for planning permission to extend the existing works. The decision came after a long discussion on a report by Mr. C. W. Davis, the surveyor. The factory is an American concern and was set up in Ellesmere Port several years ago as a dollar-earning industry.

Councillor J. Brodie, who resides in Stanney Ward which adjoins the factory, commented on the nuisance which has always existed because of the deposits of particles of carbon black from the works. The surveyor's report had disclosed that the firm in the first instance had not revealed certain facts which now came to light. Councillor W. Brown said if Cabot Carbon Limited were not permitted to extend their plant it might get round to other firms and they would not go to Ellesmere Port. They should understand that Ellesmere Port was an industrial town and that they were there to cater for industry. The factory was in its teething stage and threw off particles of carbon black only when there was a breakdown. It stood to reason the company wanted to eliminate the nuisance and he was certain they would overcome their difficulties.

Councillor J. Groome said that before permission was granted the council should insist on the existing unit first being brought to the highest state of efficiency. 'When we get an industry which proves that it can multiply itself in a short period of years and hesitates to spend money to equip the plant so as to discontinue a nuisance, then the council should not give permission until the first plant be put in order, and if they cannot do that let them take it elsewhere,' he said.

New Ideas in Chemistry

continued from page 572

structure of molecules, and the advances made have inspired general confidence that the principles governing the behaviour of molecules are now known and that what is required is a rigorous method of calculation in accordance with these principles. It appears from what has been said above that the main difficulty in the theory is in the calculation of the effect of the repulsive fields of the electrons on each other. Other aspects of the theory do not present serious obstacles to calculation. It is because of this outstanding mathematical difficulty that the successes of the theory up to date have been mainly of a qualitative kind. Calculated values of observable quantities are as a rule approximately the same as those determined by experiment, but the stage has not been reached when computation can take the place of practical determination.

Far-reaching Ramifications

None the less, the ramifications of the theory have been far-reaching. The covalent bond, which for so long was a mystery, is now understood. The gradations between covalency and electrovalency have become clear. The factors determining the shapes of molecules have become more precise. The properties of conjugated molecules have been found explicable in terms of the same principles which determine the structures of other systems. A further success of the theory has been in bringing into close relation to each other the chemical and spectroscopic properties of molecules. It is now possible to understand the conditions under which molecules may show colour and promising progress has been made in advancing a theory of dyes. Much remains to be done but the prospect is bright.

In justification of the theme of this address some words written by Faraday to Clerk Maxwell may in conclusion be quoted. 'When a mathematician engaged in investigating physical actions and results has arrived at his own conclusions, may they not be expressed in common language as fully, clearly and definitely as in mathematical formulae? If so, would it not be a great boon to express them so—translating them out of their hieroglyphics that we might work upon them by experiment—' It may not be possible for the theorist of today to attain an ideal so clearly set forth, but the task remains clear and insistent, now as then, that the attempt be made to express as simply and clearly as possible the physical meaning of the mathematical theories that have swept through the whole of chemistry.[1]

[1] I am indebted to Dr. S. C. Nyburg for working out and drawing figures 1, 2 and 3, to Dr. R. C. Sahni and the Faraday Society for permission to use figures 4 and 5, and to Dr. P. P. Manning for allowing me to refer to his unpublished calculations on butadiene. I am also grateful to Prof. H. D. Springall, Prof. I. N. Sneddon and Dr. S. C. Nyburg for reading this address in proof and for their valuable suggestions.

Micro-Electrode Devices for Potentiometric & Other Electrometric Titrations

by JOHN THOMAS STOCK, M.Sc., Ph.D., F.R.I.C.
(Norwood Technical College, London S.E.27)

ALTHOUGH the apparatus to be described was developed mainly for micro and semi-micro titration, it is of course equally applicable to work to be carried out on the normal scale.

Reference Electrodes

The micro reference electrode vessel shown at (a) in Fig. 1 has an overall length of about 55 mm. It is constructed merely by drawing out one end of a length of 6 mm. outside diameter glass tubing; the bore at the narrow end should be about 1.5 mm. A tiny plug of agar gel saturated with potassium chloride[1] forms the 'salt bridge' between the reference system and the solution to be titrated. This plug also serves to retain the liquid contents of the reference electrode vessel and, if necessary, may be renewed after each titration or set of titrations. Procedure is as follows:

Three grams of agar-agar powder are added to 100 ml. of cold saturated potassium chloride solution contained in a beaker. The latter is then covered with a watch glass to minimise evaporation and is heated on a water bath. The mixture should be stirred at intervals until a uniform viscous liquid is obtained; if necessary, a few drops of distilled water should be added to compensate for evaporation. The mixture is then poured into a warmed petri dish so that a layer some 5 to 7 mm. thick is formed. Having covered the dish, it is set aside to cool, when the fluid will set to a stiff gel.

The prepared disc of gel may be stored in a desiccator vessel which contains a little saturated potassium chloride solution in place of the usual desiccant. Drying-out does then not occur. If this method of storage is used, the supporting plate of the container should be of porcelain and not of perforated zinc, so that corrosion of the plate does not occur.

To set up the reference electrode, the vessel is placed narrow end downwards in a 10 mm. depth of distilled water contained in a small beaker. The water is boiled gently, when the electrode vessel is removed, the water shaken out and the hot extremity at once thrust into the prepared agar disc, as shown at (b). If the vessel is withdrawn with a slight twisting motion, its end becomes plugged with the gel; if insufficient of the latter is picked up, a second insertion may be made to augment the length of the plug. The electrode vessel is then returned to the boiling water, held vertically for about 3 seconds, then at once withdrawn and allowed to cool. The object of this final operation is to seal the plug to the walls of the vessel.

An appropriate solution is then introduced into the electrode vessel by means of a teat pipette with a fine extremity. The vessel should be about two-thirds filled and formation of air bubbles in the liquid column just above the agar plug should be watched for. Such bubbles greatly increase the electrical resistance of the electrode system; if necessary, gentle shaking as with a clinical themometer may be used to dislodge them.

A 3 in. length of No. 26 gauge platinum wire forms the reference electrode proper. About one half of the wire is formed into

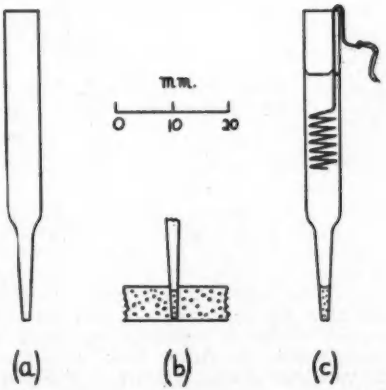


Fig. 1. Construction of the micro reference electrode

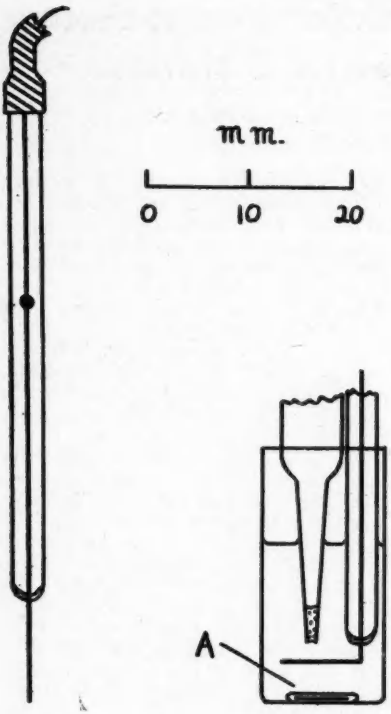


Fig. 2. Indicator electrode and modification for small volumes

a spiral by winding round a thin glass rod. The spiral should slide easily into the electrode and is supported from the rim of the latter by bending the wire hairpin-fashion, as shown at (c). A light flexible copper connecting lead is soldered to the projecting end of the electrode.

With this electrode, a buffer which is 0.01 N with respect to hydrochloric acid and 0.09 N with respect to potassium chloride is a useful solution[2,3]. Before introduction into the vessel, the solution is saturated with quinhydrone by shaking with a little of this solid. The potential of the electrode is 0.6992 volt at 25°, with reference to the normal hydrogen electrode. The actual potential may, however, be adjusted between quite wide limits by substituting other buffers for the hydrochloric acid-potassium chloride mixture.

The silver-silver chloride reference system is another very useful one. The electrode proper is a 3 in. length of pure silver wire (alternatively a platinum wire electrode may be silverplated[4]), one half of which is formed into a spiral. It is well cleaned by washing with concentrated ammonia, rinsing thoroughly, immersing briefly in 1:1 nitric acid and thoroughly rinsing a second time[5]. The electrode is then lightly coated with silver chloride by briefly anodising in dilute sodium chloride solution.

With this electrode, an appropriate solution is one that is saturated both with potassium chloride and with silver chloride. The potential is then +0.197 volt with reference to the normal hydrogen electrode, or −0.045 volt with reference to the saturated calomel electrode. This solution is made by the addition of one or two drops of 1 M silver nitrate to saturated potassium chloride solution, so that the latter becomes saturated with silver chloride[6]. Whereas the platinum electrode may be stored dry after rinsing and, if necessary, may be cleaned by flaming, the silver-silver chloride electrode should be kept immersed in the solution used for filling the electrode vessel.

Indicator Electrode

Fig. 2(a) shows the construction of the indicator electrode, the body of which is a 50 mm. length of 3 mm. outside diameter glass tubing. The electrode proper is the 10 mm. length of No. 26 SWG wire projecting from the lower end. The nature of the wire depends upon the particular titration to be carried out; whereas a platinum wire may be readily sealed into the glass, a silver wire is normally cemented in, e.g. with sealing wax. Successful seals of silver wire may however be made in lead glass[7]. A thin flexible connecting lead is soldered to the other end of the wire and, to minimise drag on the joint, may be brought out through a sleeve of cycle valve tubing.

When the depth of the solution to be titrated is small, the indicator wire may be bent at right angles, so that it lies in a plane just below the extremity of the reference electrode. Using a cut-down 12 mm. bore specimen tube as a titration vessel, as shown

at (b), samples of volume 1 ml. or less may be satisfactorily titrated.

A simple and effective method of supporting the pair of electrodes is by means of a thin rubber band stretched over an electrode holder. The head of this device is made from a rectangle of sheet copper or soft brass about 1½ in. long by ⅜ in. wide by 1/32 in. thick. This is notched deeply at both ends and a central screw-hole is drilled, as shown at (a) in Fig. 3. The strip is then bent twice at right angles as shown at (b), when a piece of 6 mm. outside diameter glass tubing placed in the notches as indicated in broken lines should lie parallel to the central portion of the strip.

Pieces of stiff brass wire (e.g., pins with points removed) about ¼ in. long are next sweated into each of the right-angle bends as shown at (c). The projecting wire ends are hooked by bending them a few degrees away from the notches and the construction is completed by attaching a 6 in. long stem of ⅛ in. diameter hardwood dowel rod by means of a woodscrew passing through the central hole. This enables the holder to be gripped in an ordinary boss-head mounted on a retort stand. The rubber band retaining the electrode-pair is stretched over the hooks as indicated at (d).

This method of mounting permits rapid setting-up and dismantling and, although the electrodes are firmly retained, the crushing action of a screw-type clamp is absent. If desired, the connecting leads may be passed through cross-holes drilled in the stem, so that any accidental drag will not be transmitted to the electrodes.

Stirring

In any form of electrochemical tritration, adequate stirring is essential. A magnetic stirrer is particularly useful when micro titrations are to be performed, since the drive is from underneath the titration vessel, the mouth of which is already fairly well filled by the electrodes and burette-tip. Further, the agitation, extremely powerful at the bottom of the solution, occurs without splashing. The construction of such stirrers is very simple [8,9]; the bar (A, Fig. 2) is about 7 mm. long and is made by sealing a fragment of a sewing needle within a piece of melting-point capillary.

Although the change in EMF during the titration may be followed using an ordinary slidewire or dial-type potentiometer and a sensitive null-point galvanometer, a direct-reading electronic instrument such as a commercial *p*H meter is much more convenient. Such instruments possess the additional advantage of drawing negligible current from the electrode-system. Changes in concentration due to electrolysis and polarisaton effects are then likewise absent, so that the meter may be left connected during the whole titration process, thus affording continuous indication.

Additionally, titration is still possible when the electrical resistance of the titration system is quite high; this is of importance in the titration of highly-dilute aqueous solutions or of certain non-aqueous ones. Since the electrical measurements are made solely as a means of end-point detection, absolute values are not necessary. A simple one-valve battery-operated titrimeter[10] thus gives excellent results; more elaborate or mains-operated versions may be constructed if desired[11].

Titration curves of 1 ml. portions of approximately decinormal hydrochloride and acetic acid solutions with normal sodium hydroxide are shown in Fig. 4. A platinum indicator electrode was used and the acid solutions were saturated with quinhydrone. In this particular case, the titration was followed using a simple one-valve direct-reading *p*H meter[12]. Where the potential 'jump' in the region of the end-point is not large or, more particularly, when precise results

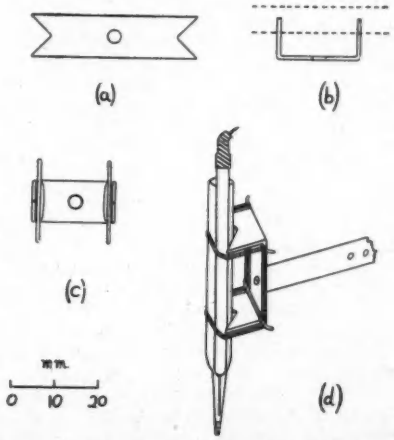


Fig. 3. Construction of electrode holder

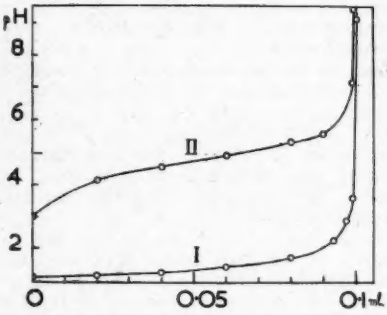


Fig. 4. Titration curves: I hydrochloric acid; II acetic acid

are required, the plotting of $\Delta E/\Delta V$ (the rate of change of EMF per unit increment of titrant) against V (the volume of reagent added) is valuable, since the curve has a maximum at the end-point[13].

Titration to Equivalence Potential

Whereas the iodide-silver titration is possible by the normal method in extremely dilute solution[14,15], the appreciable solubility of silver chloride causes this method to fail in chloride-silver titrations even when the concentrations are considerably higher. Thus, Kolthoff and Kuroda[4] found that when a 5×10^{-5}N chloride solution containing potassium nitrate and nitric acid was titrated with silver nitrate until the excess of the latter was 100 per cent, the total change in voltage was only 0.045, and end-point location by the maximum in $\Delta E/\Delta V$ was not possible. Such location could however be accomplished by titrating to equivalence potential. In this method, the EMF E_a of the system is first carefully determined with the electrodes dipping into a solution of composition corresponding to a sample which has been titrated to exact equivalence.

For carrying out the actual runs, the potentiometer is set to the value of E_a and titration is proceeded with until the initially-large galvanometer deflection is reduced to zero. Over-titration is indicated by the reversal of the direction of deflection.

A simplification of this method is the Pinkhof-Treadwell technique[16], in which the potentials of the electrodes are arranged to become identical at the end-point, so that the EMF of the system becomes zero at this point. No potentiometer is then needed. the electrodes being connected to a suitable galvanometer and tapping key arranged in series. The titration is stopped at zero galvanometer deflection. An example of this procedure is the argentometric titration of chloride with a silver-silver chloride electrode, a similar electrode dipping into a saturated solution of silver chloride in the same medium being used as the reference electrode[6]

Fig. 5

Since it is the potential, and not the nature, of the reference electrode which is important, the Pinkhof-Treadwell technique is sometimes operated with dissimilar electrodes. An example quoted by Lingane[17] is the titration of iodide with silver nitrate solution, using a silver indicator electrode and a quinhydrone reference electrode in a buffer of *p*H 6.1.

When used for argentometric titrations, the agar plug in the extremity of the reference electrode vessel should contain an electrolyte which does not react with silver nitrate. Even so, if the solution within the electrode vessel contains chloride, etc., appreciable errors may be caused by quite slight leakage into the sample, particularly when the latter is of small volume and highly dilute. In such cases, the arrangement shown in Fig. 5 is satisfactory; the reference electrode vessel dips into a halide-free solution such as 0.5N potassium nitrate in 0.1N nitric acid, which is retained in the lower vessel by a plug of agar gel made up in the same medium.

(To be continued)

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US Coal Chemicals Output Rises

Price Increase Followed Decontrol

PRODUCTION of oven and beehive coke, excluding breeze, in 1953, as reported to the Bureau of Mines, United States Department of the Interior, totalled 78,800,000 net tons, a gain of 16 per cent over 1952 but nearly 500,000 tons short of the record output of 1951. The oven-coke segment of the industry started the year with a high production rate which was sustained through the second and most of the third quarter. In September the rate started to go down, and at the end of the year slot-type coke ovens were operating at only 85 per cent of capacity.

The slackening in steel production in the latter months of 1953 caused blast furnaces to reduce their operating rates, which in turn reduced coke requirements. In spite of the decline in coke-oven operations in the last quarter, production from this source for the year was the highest on record. The output of 73,600,000 tons of oven coke, excluding breeze, was 9,700,000 tons higher than the 1952 total, which was affected by strikes, and 1,600,000 above the previous maximum of 1951.

Effect of Steel Recession

The recession in steel production adversely affected beehive output and a large number of beehive plants closed in 1953. Production of beehive coke averaged more than 500,000 tons a month during the first half of the year but dropped steadily in the last half. Expansion in slot-type carbonising capacity was also an important factor in the sharp decline in beehive production.

Prices of coke and coal chemicals which had been under regulatory ceilings (Supplementary Regulation 13 of the General Ceiling Price Regulation) since 16 March, 1951, were decontrolled by the Office of Price Stabilisation on 18 February, 1953. The removal of ceilings had little immediate effect on coke prices. Although prices on most of the coal chemicals advanced slightly, prices on pure benzene increased sharply. Spot prices quoted in trade journals showed that coke-oven pure benzene increased from $0.34 per gal. to $0.41 during the year.

Production of the primary coal-chemical materials and derivatives at coke ovens followed, in general, the increase in coke output. Increases ranging from 16 per cent for gas to 19 per cent for crude light oil were registered by the primary products. The increases in production of derivatives, influenced by demand, fluctuated widely and were as follows: benzene, 15 per cent; toluene, 18 per cent; xylene, 23 per cent; crude naphthalene, 6 per cent; refined pyridine, 4 per cent; ammonium sulphate, 18 per cent; and ammonia liquor, 13 per cent.

Changes in Market Conditions

Expansion in productive capacity, imports, and a drop in requirements caused some significant change in market conditions of some of the important coal chemicals. Imports of ammonium sulphate (523,858 tons) were the highest on record in 1953 and were more than half of the production of coke-oven sulphate in the United States. About two-thirds of this foreign material originated in European countries and entered the United States through Eastern ports. European sulphate was offered for sale around Eastern Seaboard ports for about $44 per ton and was delivered to points in the south-eastern part of the United States at lower prices than domestically produced coke-oven sulphate. Sales of coke-oven sulphate lagged far behind production during the summer and autumn and stocks at producing plants reached a record figure in November. Stocks declined slightly in December as sales increased sharply following price cuts.

The rapid expansion in naphthalene-producing capacity beginning with the 1950 defence programme began to show its effect on the market early in 1953. Demand started the year at a slow pace and a six-month strike at a large naphthalene-consuming plant added to the sluggishness of the market. In addition, 41,668 tons of crude naphthalene was imported, mainly from European countries, and sold at port of entry for a price of approximately $0.035 per lb. compared with a price of $0.0675 for domestically produced material. The slackened demand coupled with the large imports resulted in a temporary oversupply and the

first price cut was made in domestic material since 1950. Benzene, one of the most essential chemicals for civilian and military goods, started the year in short supply and ended in a balanced position. Benzene was used principally in the manufacture of styrene, phenol, and aniline. The large demand for all these materials built up during the Korean emergency carried over in the first part of 1953. The cutback in the Government synthetic rubber programme in the latter part of the year reduced requirements of chemical grades of benzene. In order to maintain maximum production of benzene and prevent accumulation of excessive inventories, a few coke producers sold a small amount of surplus benzene as motor fuel. Although some benzene was sold in this manner, the price on specification grades of benzene was not reduced.

The increase in oven-coke production and sales of coal chemicals raised the value of all coke-oven products to more than $1,500,000,000 in 1953. This was $234,000,000 higher than in 1952 and $418,000,000 above the 1947-49 average.

New Stand is Collapsible

TO overcome the problems of high costs of participating in overseas trade fairs, SIMA —Scientific Instrument Manufacturers' Association of Great Britain—have developed for their members a simple, entirely self-contained, and easily transportable display stand. The display unit consists basically of a central panel with a pedestal in front of it, on which a single instrument may be shown, and two side panels on which photographs of other products may be mounted. The pedestal has a space for sales and technical literature, and a slot for inquiries.

The stand can be easily collapsed and folded flat for transport by road, rail, sea or air, and may be erected anywhere without skilled labour. One unit can stand alone or any number may be built up into a variety of patterns and shapes, from a rectangle with a temporary office in the centre, to a straight line which can be erected in the corridor of a public building.

This flexibility is being fully exploited by SIMA, who intend to send their touring exhibition to various European countries, to show their members' products not only at established fairs and conventions, but wherever there is sufficient interest.

Scheme Completed

THE post-war expansion scheme at Anglo-Iranian's Grangemouth Refinery, on the Firth of Forth, was recently completed with the commissioning of the last three units—a 60,000 tons a year catalytic polymerisation unit, a Girbotol unit, and a sulphur recovery unit. The scheme has raised crude oil capacity from 360,000 tons a year immediately after the war to 2,700,000 tons today.

The sulphur recovery unit will initially produce about 14 tons of sulphur a day. Gas from the cracking plant first passes through the Girbotol unit, which removes its sulphur content. Then it is fed into the catalytic polymerisation unit, and processed into two products—high octane motor spirit and tetramer, which is piped to British Petroleum Chemicals Ltd. adjoining the refinery.

The sulphur extracted by the Girbotol unit is processed into flake sulphur, which is transported by road to Broxburn oil works, where it is made into sulphuric acid.

KID Exemptions

THE Treasury have made an order under Section 10(5) of the Finance Act, 1926, exempting the following from Key Industry Duty, for the period beginning 15 September 1954, to 18 February 1955:

2,5-Dihydroxybenzoic acid; furfuryl alcohol; 3-pyridylmercury acetate; and 2,4-xylenol.

This Order is the Safeguarding of Industries (Exemption) (No. 9) Order, 1954, and is published as Statutory Instrument No. 1191.

Micro-Electrodes

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CHEMISTRY OF THE DEFECT SOLID STATE. By A. L. G. Rees. Methuen & Co., London. 1954. Pp. 133. 8s. 6d.

It is always gratifying to read a book on the solid state of matter which has been written by a chemist. Dr. Rees has produced a monograph which will make interesting reading for anyone working in the field, and will also be of use to those non-specialists, who wish to learn something of the problems which concern the solid state chemist.

Chapter I describes and defines the common defect centres in solids and in this chapter also there is a useful attempt to evolve a notation for the description of defects. Chapter II gives an all too brief account of the 'chemical' (or corpuscular) and of the wave mechanical approaches to the theory of defects and Chapter III describes the sort of information about defects which can be derived experimentally. As one would expect there is no attempt made to describe the details of the experimental techniques. The following three chapters briefly review the reactivity of solids, simple solid reactions and surface reactions. The final chapter, of two pages, points towards the future advances which can be made in the subject.

A bibliography is appended, but the reviewer feels that this should have been called instead 'references,' since there are a number of glaring omissions from it as a bibliography. In particular, while Jost's 'Diffusion und Chemische Reaktionen in Festen Stoffen' is listed, his later edition 'Diffusion in Solids, Liquids and Gases' is not. Hedvall's two monographs are also missing from the list, as are Mott and Gurney's book and the important 'Imperfections in Nearly Perfect Crystals,' the report of the 1950 symposium.

Apart from these sins of omission, the reviewer feels that Methuen are to be congratulated on adding this book to their range of monographs and has no hesitation in recommending it.—W. W. HARPUR.

WOOL—ITS CHEMISTRY & PHYSICS. By P. Alexander and R. F. Hudson. Chapman & Hall, London. 1954. Pp. 404 + vi. 45s.

In spite of the great advances in knowledge of the chemistry and physics of wool made in the past 20 or so years there has been, up to now, no comprehensive monograph covering the subject. This book, the authors of which are well known for their research work on a variety of problems concerning wool, goes far to fill the gap. It is intended not only for research workers on protein fibres and other branches of protein chemistry but also for the practical worker in industry, so that the accumulated data may be used to assist in the development of new processes. For this reason, throughout the book, general explanations on an elementary level precede the introduction of more advanced concepts. Industrial processes are not described but the practical significance of the physical and chemical aspects is indicated.

About half the book is concerned with the physics of wool. The morphological structure is first considered, the different phases being illustrated by some very clear diagrams and photomicrographs. A chapter on surface properties includes surface area and its determination, some electrical and frictional properties, the latter including a discussion of frictional coefficients, the direct frictional effect and the mechanism of felting. Deposition of polymers to render wool unshrinkable is also discussed. The elasticity of wool, the contribution of different bonds to fibre strength, the thermodynamics of elastic deformation, and supercontraction are considered under mechanical properties. Diffusion processes and the related subject of absorption are dealt with in considerable detail, the treatment being applicable to many systems other than wool. This extension is justified, in the author's view, by the fact that these subjects have advanced very rapidly in the past few years and the resulting knowledge may have important

Chemist's Bookshelf

application to problems of the textile industry. The influence of swelling on absorption, diffusion and electrical properties is also discussed.

The remainder of the book deals with the chemistry of wool. Acid-base characteristics are first discussed and the theories of Steinhardt and Harris, of Gilbert and Rideal and the use of the Donnan theory considered in some detail. There is a chapter dealing briefly with ion exchange and dyeing equilibria. A chapter on the disulphide bond deals with its reduction, the hydrolysis of wool in neutral solution, its photochemical oxidation, the reactions of wool with peroxides, peracids and halogens, and the relationship between disulphide bond breakdown and the production of non-felting wool. Consideration of the chemical reactivity of wool includes acid, alkaline and enzymatic hydrolysis, the influence of heat and the reactivity of particular groups in the wool fibre. The formation of new cross-links, the rebuilding of disulphide bonds and the formation of polymers within the fibre are also discussed. A chapter on the chemical composition of wool considers the amino-acids present, their order in the peptide chain and fractionation into different polypeptides. The final chapter, on the stereochemistry and macromolecular structure, gives a critical survey of modern views of the structure of β-keratin and the nature and stability of the α-fold. The micellar structure of keratin fibres is also discussed.

Many of the theories discussed are not yet fully established and some are controversial. While presenting a balanced account the authors have not hesitated to indicate which of these, in their opinion, is the most acceptable, pointing out, however, that new data may lead to the modification or abandonment of many plausible theories. Indeed, as is inevitable in a rapidly advancing subject, some modifications have been made since the book was written. Emphasis on controversial aspects may act as a stimulus to research workers. While no attempt is made to provide a complete bibliography each chapter concludes with an extensive list of references. The authors are to be congratulated on a book of value not only to those concerned with wool but all interested in the science of fibres.—W.R.M.

BILDER ZUR QUALITATIVEN MIKROANALYSE ANORGANISCHER STOFFE. By Wilhelm Geilmann. 2nd edition. Verlag Chemie, GmbH. Weinheim/Bergstr. 1954. Pp. 120. 393 illustrations and 50 plates. DM. 20.80 (full cloth).

The first edition of this book was published in 1934 and caused great interest. In the intervening years much progress has taken place in microscopic qualitative analysis and the author feels that considering these facts this new edition merits publication. The book is essentially a 'picture-atlas' of reaction products which are suitable as tests for elements in microscopical qualitative analysis. The arrangement of the photo-micrographs, which are excellent throughout, corresponds, in contrast to the first edition, to the usual groups of qualitative chemical analysis, the alkali metals being first considered, followed by the alkaline earth metals and so on.

The photo-micrographs are similar to those of Chamot and Mason in 'Handbook of Chemical Microscopy, Vol. II' (which is indeed one of the literature references); however, many more tests are applied in this book under review and the uncommon as well as the common metals are extensively covered. The anions are collectively gathered together. The photographs were taken with a Zeiss-Winkel microscope and a 9 by 12 vertical camera. To get depth sharpness a photo-ocular of 12-17.5 magnification was used in conjunction with weakly magnifying objectives.

On the page adjacent to each plate of photographs the information relating to each test is given in an abbreviated, though very satisfactory, form, i.e., the formula of the reaction viewed; colour and crystal classification and magnification used; method of carrying out the test; preparation of the reagents used; interference from other elements and substances; and the limits of detection in micrograms of the element in a drop of 20-30μl.

The mere examination of pictures does not take the place of direct study of the actual tests, and many factors can influence the final reaction product so that the crystals may not look exactly as illustrated. Bearing these facts in mind, this book fulfils a useful purpose and can be regarded as a support to practical analysis in those laboratories (unfortunately not so common) where a microscope is available.—R. J. MAGEE.

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ASSAY AND DETECTION OF PYROGENS. The Pharmaceutical Press, London. 1954. Pp. 43. Paper, 3s. 6d.

The chairman at the afternoon session of the symposium of which this booklet is a report, Professor J. P. Todd, used the restricted definition of pyrogens as substances derived from bacteria causing elevation of blood temperature. The high activity of these substances—1μg. is sufficient to give a material response—renders their exclusion, particularly from preparations used for intravenous injection, vitally important. They are considered to be polysaccharides. Owing to their stability they are found even in distilled water unless the still has been well baffled. Dry chemicals, antibiotic preparations, even glassware can become contaminated.

Three papers read at the afternoon session follow the chairman's introduction, the first being a general account and the other two dealing with methods of testing for pyrogens by means respectively of temperature and leucocyte response in rabbits. Then follow the proceedings of the evening session under the chairmanship of Dr. H. O. J. Collier, consisting of a paper comparing the sensitivity of man and rabbit to pyrogens and another on standards of pyrogenic activity followed by some discussion and the chairman's closing address.

The whole report shows clearly the present state of knowledge and the research progress being made in this important field. It makes interesting and instructive reading.—M.C.

OUTLINE OF CHEMISTRY: A Summary for First Year Students. By E. J. Manson. Translated and revised by H. W. Turner. Blackie & Son Ltd., Glasgow. 1954. Pp. 150. 5s.

Some writers of text-books add a summary of the matter treated at the end of each chapter. This book is, as it were, a collection of such summaries from texts of inorganic, organic, physical and analytical chemistry. Accordingly, it consists of definitions, tabulated information, one-line statements of preparation methods followed by the equation, lists of properties and so on. There are no graphs or other illustrations. This is the first English edition and is a translation of the 1953 Dutch edition.

The information is clearly set out under bold headlines, but the book suffers from its origin in a country where the examination system is different, and from obscurities due to condensation. What, for instance, does this statement (p. 27) mean: 'Colloidal particles have a large surface area per unit volume. They thus have a power of adsorption (decoloration by charcoal)'?

The author states that the book is intended for first year (presumably university) students and that it 'tries to help in distinguishing between major and minor points in chemistry.' Valency therefore must be considered a minor point for it gets 3½ lines and is not related to atomic structure.

The translator claims that the book has been altered to suit the requirements of British examinations and that it is intended for evening students. It is difficult for the reviewer to see which examinations the translator has in mind. Much of the material is of our matriculation level, and, as for our advanced level and Intermediate Science examinations the requirements are not met, for the book omits boron, hydrogen peroxide, the preparation of fluorine, the transition elements, flotation and the aromatic compounds. Again, what university student would seek a revision book omitting resonance, electronegativity, orbitals, and reaction mechanisms? Moreover, the treatment is far from up-to-date. For these reasons it is not possible to recommend this book to any particular class of student. In the reviewer's opinion it is better for lecturers to encourage students to compile a revision book of their own.—G.F.

PRINCIPLES OF POLYMER CHEMISTRY. By Paul J. Flory. Cornell University Press, New York: Oxford University Press, London. 1953. Pp. 672. 68s.

From about 1930 onwards the idea became widely accepted that high polymers are composed of covalent structures many times greater, particularly in their length in many cases, than those occurring in simple organic compounds, and that this structural difference is alone responsible for their characteristic properties. This concept of macromolecules became very firmly established and as a result considerable progress was made in the succeeding years in the study of the chemistry and physics of these substances.

During the spring of 1948 the author of

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this book occupied the George Fisher Baker Non-resident Lectureship in Chemistry at Cornell University. Part of this book is based upon lectures delivered at that time, but rapid developments in polymer science have made revision and expansion necessary in the completion of the work. Consequently the present volume goes considerably beyond the Baker lectures both in scope and in the inclusion of new developments.

The size of modern polymer science and the fact that a number of excellent books on various aspects of this subject have appeared in recent years makes the selection of the material to be included a difficult one. The author decided to emphasise in his treatise the principles of polymer science. From the mass of results accumulated by various research workers over the last quarter of a century certain clear generalisations have emerged and in the view of the author the time had come to assemble them together. In his treatment the author introduces experimental results primarily for illustrative purposes and to develop the basis for the principles, and, in general, descriptions of the properties of specific polymers are not included. Although some of the more important experimental techniques are summarised, detailed descriptions of apparatus or procedures are avoided.

There are two introductory chapters, the first of which provides an historical account of the early developments of the subject. In the second one, essential definitions of terms encountered in high polymer chemistry and of the various types of polymer are described. The next three chapters deal with the reaction mechanisms and kinetics of polymerisation reactions. Condensation polymerisation, the polymerisation of unsaturated monomers by free radical mechanisms, copolymerisation and the subjects of emulsion and ionic polymerisation are all dealt with. A further section deals with the structural properties of polymers. This section includes a full account of the structure of vinyl polymers, and studies of the molecular size of these substances include an account of the determination of molecular weight and of molecular weight distributions of linear and non-linear polymers. The remaining part of the book deals with molecular configuration, rubber elasticity, and the thermodynamic and other properties of polymer solutions.

The book has been compiled on the assumption that the reader is relatively new to polymer chemistry but much of it will be found of benefit to more advanced workers. Although the literature on high polymers is now very extensive and choice from the many books now available is often difficult, the present volume should prove of much use to the many scientific workers interested in this expanding branch of chemistry.—G.S.E.

THE INFRA-RED SPECTRA OF COMPLEX MOLECULES. By L. J. Bellamy. Methuen and Co. Ltd., London. 1954. Pp. xvii + 323. 35s.

Once it became clear that the position of certain absorption bands in the infra-red region of the spectrum could be associated with the vibrations of specific groups in a molecule the way was open for the development of an analytical technique of the first importance.

The development of this technique has made such strides in the last decade that the day is fast approaching when no research laboratory will consider itself fully equipped without the use of an infra-red spectrometer. At the present time the limiting factor is cost but there are indications that cheaper instruments based on the diffraction grating technique may soon bring this important tool within the reach of a much wider range of users.

In structural studies the infra-red spectroscopist relies on a mass of laboriously acquired empirical data relating the position of absorption bands with individual units of molecular structure. The work under review which is intended for the practising spectroscopist and for those who use information derived from infra-red spectra presents a critical review of structural correlations observed in this mass of empirical data. Wisely, in a book of this kind, the author makes no attempt to discuss either the theory of infra-red absorption or the necessary instrumentation, for these subjects are much more adequately dealt with elsewhere. In any case the reader who is sufficiently advanced to make use of the correlation data will find little use for brief and probably inadequate discussion of these important matters.

The subject matter of the various chapters is arranged in a similar form so that after a little practice the information required can easily be found. At the beginning of each chapter a brief outline of the correlations to be discussed is given together with a table giving the different frequency ranges, while at the end of the chapter charts are provided in which the correlations discussed are summarised in a very convenient form. Sufficient detail is given of the origin and reliability of the correlations to enable a quick appreciation to be made of their value in any particular case. This is a feature which adds greatly to the value of the book.

The subject matter is comprehensive, more than 700 different compounds being included in the compound index. For the convenience of users a reciprocal table is also provided, wave-numbers being employed throughout the body of the book.

This is a valuable reference book, sold at a reasonable price. All practising infra-red spectroscopists will wish to have a copy while anyone interested in analysis or in structural problems will find its perusal rewarding.—R. C. PINK.

THE CHEMICAL STRUCTURE OF PROTEINS. Edited by G. E. W. Wolstenholme & M. P. Cameron. J. & A. Churchill Ltd., London. 1953. Pp. 222. 25s.

It was in June 1949 that the Ciba Foundation was opened as an international centre where workers active in medical and chemical research could meet informally to discuss ideas and exchange information. The Swiss chemical firm of Ciba Ltd. was responsible for its inception and financial maintenance although the Foundation is administered independently as a charitable trust. A number of discussion meetings, including international symposia, have been held in the five years since the Foundation was first opened. The proceedings of a number of these international symposia have been published in full, with only moderate editing, in a series of volumes.

'The Chemical Stucture of Proteins' is one of these volumes, and contains all the papers and the informal general discussions of a symposium which was held at the end of 1953 with the particular intention of bringing French workers in protein chemistry to the fore in an international gathering. In his opening remarks at the conference, Prof. Fromageot of Paris said that other symposia on protein structure had been concerned mainly with physical problems and with the physico-chemical properties of proteins as large molecules, whereas at this meeting the chemical aspect was to be emphasised, and attention would be paid more specifically to the arrangement of the amino acids in the protein molecules. It is only comparatively recently that the possibility of establishing the chemical structure of any protein has seemed remotely possible. This necessitates a knowledge of the sequence of amino acids in the peptide chains, the detection of any bonds in addition to the peptide bonds, and the determination of the number of peptide chains involved in the structure of a given protein. Only in recent years have new techniques been developed both for the separation of the fragments obtained by the partial splitting of proteins and for their characterisation.

The papers presented as the symposium fall into three main classes. Those coming in the first class are concerned with the recently developed methods available for judging the purity of a protein or peptide, and which also make it possible to obtain these substances in an exactly defined condition of purity. The establishment of the structure of an organic compound entails the preparation initially of a pure specimen. With complex substances like proteins and polysaccharides it has often been a matter of considerable difficulty to establish the purity of a compound. The papers in the second section deal with the methods which make it possible to characterise and determine quantitatively the initial (N-terminal) and the final (C-terminal) amino acids belonging to the peptide chain. The sequence of the amino acids in a protein may be determined either by splitting usually by hydrolysis of the peptide chain, and by the study of the resulting fragments, or by stepwise liberation of the terminal acids in the order of their occurrence in the chain. The papers falling in the third class deal with this subject.

The present volume should prove especially interesting to workers in protein chemistry and to those concerned in the use of chromatographic techniques.—G. S. EGERTON.

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GENERAL CHEMISTRY. By E. G. Rochow and M. K. Wilson. John Wiley & Sons, New York; Chapman & Hall Ltd., London. 1954. Pp. xiii + 602. 48s.

Most textbooks perform a dual function, to instruct in the principles of a subject and to serve for reference. As a subject like chemistry grows there is a tendency in the textbooks for the reference material to mount up and interfere with continuity. The result is loss of interest to the reader. We have come to accept the inevitability of such dull books especially in general chemistry. This American book determines from the start to be different and succeeds nearly to the end. Whereas the usual chemistry book records masses of facts, pausing from time to time to discuss theoretical considerations, this book deals with theory and principles with occasional recourse to practical data by way of illustration. For example, after atomic structure and the periodic table have been explained there comes a chapter devoted to the occurrence, extraction, reactions and compounds of copper, silver and gold. No other metals are considered in such detail apart from a chapter on general metallurgy. Non-metals are somewhat more fully covered.

It is the intelligent student's book. There is no attempt at undue simplification. Thus it is eminently suitable for those such as engineering or medical students who have not had the opportunity to do more than touch on a little elementary chemistry without reaching the truly interesting level. With the aid of this book they could penetrate into the deeper and more fascinating realms of the subject such as atomic spectra, the nature and particularly the spatial aspect of chemical bonding, crystal structure, kinetic theory, magnetic properties, electrolytic phenomena, activation energy, photochemistry, photosynthesis, chemotherapy and radiochemistry. Some of the older non-academic chemists, who have lost touch with modern trends outside their own fields, might also profit by reading this book. One can go as far as to say that it is the sort of book that every student beginning to study chemistry should have available for reading, but in addition to his usual textbook, for it cannot be claimed to replace the standard elementary textbook of inorganic and physical chemistry. It might well serve as an inspiration and stimulus to many who are failing to get to grips with these subjects in the early stages.

Although it is a most excellent work there are aspects to which exception must be taken, for example, the treatment of organic chemistry. This is introduced by a chapter mainly on petroleum, acetylene, ethylene, synthetic rubbers and plastics. Next come some giant strides through chapters on photosynthesis, biochemistry and chemotherapy. It is difficult to imagine how anyone not already well versed in organic chemistry could benefit appreciably from this top-speed tour. The authors would have been well advised to restrict organic chemistry to a chapter on fuels unless they were prepared to tackle the subject in the way they have done inorganic and physical chemistry, namely by detailed treatment of theoretical principles, instead of reciting this mass of facts and applications unleavened by sufficient fundamental theoretical discussion.

The book is beautifully produced and well illustrated with original diagrams, although there are very few showing ordinary pieces of chemical apparatus. The two misprints on p. 71 are exceptional. The formula for carbon suboxide is given wrongly on p. 350. The process of 'sulphonation' mentioned on p. 384 is better described as 'sulphation.' CuI for cuprous copper is very confusing. The wording is careful but there are a few misleading statements, e.g. inferring that chemiluminescence is restricted to tropical seas or that the sea was the only source of salt for the ancients while the suggestion on p. 137 'if the population of the earth were to increase a millionfold' is ridiculous. Nevertheless, it is a most refreshing and commendable book which makes a new approach to the teaching of chemistry at that most awkward stage, the student's first year. —M. CRAWFORD.

Eight Hurt in I.C.I. Works Explosion

Windows were blown out and part of the wall fell when a vat of dyestuff exploded at the I.C.I. works at Blackley, Manchester, on 11 September. Eight people were injured. The majority of workers had just left the building for lunch when the explosion took place.

HOME

Scots see I.C.I. Developments

I.C.I. Ltd. (Nobel Division) have a large stand at the Scottish Industries Exhibition at Glasgow, which closes on 18 September. Prominence is given to their Ardil protein fibre, made at Dumfries, and there is also a display of silicones. Work is now progressing at Ardeer on a commercial plant to produce industrial silicones, and considerable progress is expected in the next few months.

Match Firm Burned Out

The directors of the North of England Match Company, whose factory in West Hartlepool was recently destroyed by fire, have announced that the company will not resume business.

Appeal Allowed

The Minister of Housing and Local Government has allowed an appeal by Leather's Chemical Company Ltd. of Bradford, against Bradford City Corporation. The company wished to make extentions to their works, and the corporation sought to impose a 15 year limit on the extension. The Minister has allowed the appeal, on condition that precautions are taken to minimise nuisance from the residual fine oxide dust and that not more than two Glover units, including units comprised in the existing works, should be in operation at any one time.

Liquid Assets

Two firms—I.C.I. and Dorman Long—have between them guaranteed £3,500,000 of the £8,250,000 which the Tees Valley Water Board proposes to spend on capital developments in the next ten years. If the firms do not take the water made available by the developments, they are bound by the agreement to pay interest and redemption charges amounting to £186,000 a year.

Oil Industry Orders Up

Bulk chemicals formed the largest single item bought by the oil industry in the first half of this year. They accounted for £10,735,400 of the total of more than £39,000,000 in orders for equipment and materials placed by the oil industry with British firms. Orders were worth £3,000,000 more than in the first half of 1953.

Terylene Council Move

The Terylene Council of Imperial Chemical Industries Ltd., the headquarters of which has been at Welwyn, Hertfordshire, since 1951, is moving to Harrogate during September and October this year. With the exception of the research department, the move will be completed by 18 October, and the new address will be Imperial Chemical Industries Ltd., Terylene Council, Hookstone Road, Harrogate, Yorkshire.

August Steel Figures Highest Ever

Steel production last month averaged 325,600 tons a week, 34,200 tons higher than the weekly average in August, 1953, and the highest ever achieved in the month of August, when production is affected by holidays. Pig iron production averaged 227,400 tons a week, an increase of 23,000 tons over the figures for the same month last year. The largest increases in output were in South Wales and Monmouthshire.

Subsidiary Company Disposed Of

The directors of Oxley Engineering Co. Ltd., gas, chemical and structural engineers, Clarence Street, Leeds, have announced that the company has disposed of the subsidiary company A. and W. H. Bury (Darwen), Ltd. (repetition foundry) to J. Vickers & Son.

British Firm to Equip Pakistan University

Quickfit & Quartz Ltd., manufacturers of interchangeable laboratory glassware, of Stone, Staffs, have contracted to supply the entire glassware needs of the chemistry department of the University of Sind at Hyderabad, Pakistan. The university, when completed, will be one of the largest on the sub-continent of India; its buildings will extend over an area of 15 sq. miles. Crates of standard Q. & Q. interchangeable parts are already being prepared for shipment to Pakistan.

More Strikes

Industrial disputes in the chemicals and allied trades in the first seven months of the year involved the loss of 1,000 working days; 200 workers were involved in a total of five stoppages. In the same period of last year there was only one stoppage, involving less than 50 people.

OVERSEAS

Portuguese Import Tariff

An *ad valorem* tariff of between 1 per cent and 2 per cent has been imposed by the Portuguese Government on imports of octyl alcohol.

Cobalt 'Bomb' for NZ Hospital

Sir Arthur Sims has presented New Zealand with a cobalt 'bomb' for deep therapy treatment of cancer. Costing between £25,000 and £30,000, the 'bomb' will be installed at Christchurch Public Hospital.

Petroleum Production in USA

US production of crude petroleum averaged 6,500,000 barrels daily in June, an increase of 29,000 barrels a day compared with May. Total crude runs to stills (including imports) at a daily average of 6,947,000 showed a decrease of 91,000 barrels. Total stocks of refined products at 30 June were 441,104,000 barrels, a gain of 6,700,000 during the month.

Chile's Copper Sold

All Chile's copper production for the current year has been sold, it is reported, and only fire refined copper is now being offered. Output, without allowing for quantities lost through strikes, is estimated at 300,000 metric tons.

Two Brazilian Penicillin Plants Open

E. R. Squibb and Sons have officially opened their new $250,000,000 penicillin plant in Santo Amaro, on the outskirts of Sao Paulo, Brazil. Sir Alexander Fleming, discoverer of penicillin, went to Brazil to preside over the opening ceremony. Initial production of the Squibb factory is 1,800,000,000,000,000,000 units per month, half the present Brazilian consumption; it can be doubled by the addition of four more fermentation tanks. The plant, the largest outside the US, will use almost exclusively Brazilian raw materials. The aim is to produce 100 per cent Brazilian penicillin within 18 months. Sir Alexander also went to Sorocaba, near Sao Paulo, for the opening of a second penicillin factory belonging to the Fabrica Nacional de Penicilina Fontoura, one of Brazil's biggest pharmaceutical manufacturers.

Plastics Exhibition

An International Plastics Exhibition is to open on 3 October in Oslo. It will be on the same site as a recent Norwegian Industries Exhibition which was visited by 210,000 people in 17 days.

American Secondary Lead Production

Output of the secondary lead industry in the United States in June totalled 44,500 tons, consisting of 33,500 tons of secondary pig metals, 6,500 tons of fabricated products and 4,500 tons of pig, bar and ingot containing 50 per cent or more of primary metals.

No Stop to Manganese Stockpiling

The US Government will not at present expand its purchases of US-produced low-grade manganese ore for the national stockpile, it is announced. But purchases are not to stop, and offshore buying will continue.

Australian Oil Search

Australian Oil Exploration has been granted authority to prospect over an additional area of 19,500 sq. miles in south western Queensland and an additional 4,500 sq. miles in the Reids Dome area.

New Steel Company for Brazil?

The creation of a joint public and privately-owned company which would erect and operate a steel mill with an output of 900,000 tons in Vitoria, Brazil, is being considered. The same company would establish a second steel plant at Laguna, in the State of Santa Catarina, the principal coal-producing region, with an annual capacity of 450,000 tons.

New Petrol Company

A new petrol-distributing company, in which an American enterprise, Anglo-United Petroleum, USA, has shares, will begin marketing 86 octane petrol in Australia next year. The local company, Anglo-United Petroleum Ltd., claims that the petrol will be of the highest quality yet sold to Australian motorists. Supplies will come from the Taipeh refinery in Formosa. Plans to erect a seaboard terminal at Sydney, with a storage capacity of 8,000,000 gallons, are well advanced.

PERSONAL

The Lord President of the Council has appointed MR. E. ASHBY, MR. S. BARRATT, PROFESSOR E. A. G. ROBINSON and MR. C. SYKES members of the Advisory Council for Scientific and Industrial Research. Their appointments will date from 1 October. They succeed Professor R. S. Edwards, Lord Halsbury, Sir Henry Hinchliffe and Mr. A. H. Wilson, who are to retire from the council on completion of their terms of office on 30 September. Mr. Ashby is president and vice-chancellor of Queen's University, Belfast, Mr. Barratt finance director of Albright & Wilson, Oldbury, Professor Robinson, Professor of Economics, Cambridge University, and Mr. Sykes managing director of Thomas Firth & John Brown.

DR. WILFRID HILL, who founded the County Chemical Co. Ltd., Shirley, near Birmingham, 60 years ago, has notified his fellow-directors that he intends to retire on 1 July, 1955. Dr. Hill, now living at Brighton, is 86 years old.

To mark the completion of 25 years' service with his company, his colleagues in the metal finishing division and laboratories have presented MR. W. E. WRIGHT, a director of the Pyrene Co. Ltd., with his portrait painted by S. J. Iredale. Throughout his long association with the Pyrene Company, Mr. Wright has been in charge of its metal finishing division and was the first man to promote in this country the adoption, on a fully commercial scale, of phosphate processes for rust proofing and later on for paint bonding.

At Bradford Cathedral, on 11 September, MISS PATRICIA SHEARD, elder daughter of Mr. and Mrs. W. H. Sheard, of Hollingwood Mount, Lidget Green, Bradford, was married to MR. COLIN CATCHPOLE, of Temple Grove, Halton, Leeds. The bride is on the research staff of the Bradford Dyers' Association.

MR. T. C. A. HUTCHISON, deputy supply manager at the Wilton works of Imperial Chemical Industries Ltd., has received a presentation from the staff on leaving to take up an appointment with I.C.I. Nobel Division, Glasgow.

The Textile Institute Medal, inaugurated in 1921 as an award by which recognition could be given for distinguished services to the industry in general and to the Textile Institute in particular, will be presented to SIR ERNEST WILLIAM GOODALE, C.B.E., M.C., by the Institute's president, MR. C. H. COLTON, on the occasion of the Autumn Convocation to be held on 24 September. Sir Ernest, who was president of the Textile Institute from 1939 to 1940 and chairman of the Institute's London section from 1950 to 1952, has served on many governmental, commercial and industrial committees. He is the 37th recipient of the medal. The Warner Memorial Medal, awarded in recognition of outstanding work in textile science and technology will be presented to MR. REGINALD MEREDITH, M.Sc., F.Inst.P., of the College of Technology, Manchester.

The wedding took place at the Presbyterian Church of St. Andrew and St. George, Stockton-on-Tees, on 9 September, of MR. DUNCAN HARGREAVES BOOTHMAN, younger son of Mr. and Mrs. P. R. Boothman, of Woodlands, Utley, Keighley, and MISS BARBARA LILY JACKSON, younger daughter of Mr. and Mrs. J. D. Jackson, of Hartburn, Stockton. The bridegroom, a graduate of Leeds University, is a technical maintenance engineer at Imperial Chemical Industries.

Election of officers of Olin Mathieson Chemical Corporation, USA, formed on 31 August by the merger of Olin Industries Inc. and Mathieson Chemical Corporation, has been announced by MR. JOHN M. OLIN, chairman of the board, and MR. THOMAS S. NICHOLS, president. Executives include MR. JOHN W. HANES, chairman of the finance committee and vice-president for finance, and MR. F. STILLMAN ELFRED, MR. JOHN C. LEPPART and MR. STANLEY DE J. OSBORNE, executive vice-presidents.

Will

MR. JOHN SHARP, of Hill Cottage, Falmouth Avenue, Newmarket, late a director and member of the executive committee of Bradford Dyers' Association Ltd., left £17,197.

Publications & Announcements

THE 1954 approved list of crop protection products, issued by the Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland, gives a list of proprietary products which comply with standards of composition and performance approved by the Ministry and the Department for the purpose given on the containers. The approval relates only to Great Britain and to a period after the manufacture of a product covering at most two seasons of application. Included in the list, which replaces the one issued in January, 1953, are insecticides, fungicides, seed dressings, smokes and weedkillers.

* * *

CLAIMS that the Tubix dust collector has increased the scope of multi-cyclone collectors and gives a high recovery efficiency usually associated with more expensive systems are made by the makers, Thermix Industries Ltd., in a new brochure. The multi-cyclone method of dust separation from gases is well established, says the brochure, but the introduction of gas through a specially designed slot, the arrangement of the cyclones and the decantation of large particles into a primary hopper are special features of the Tubix patented design. The brochure is available on application to the firm.

* * *

AS a contribution to current thinking on the status of management as a profession Mr. L. Urwick, chairman of Urwick, Orr & Partners Ltd, management consultants, of Urwick House, 29 Hertford Street, Park Lane, London, W.1, has set out his views on the subject in a paper entitled 'Is Management a Profession?' which has now been reprinted for distribution.

* * *

LUBRICATION is essential if moving machinery is to operate efficiently, but the degree of that efficiency will depend largely upon the system selected for applying the lubricant. Tanway 'GP' lubrication—described in a booklet just published by Tanway Ltd., Barnby Dun, Doncaster—is an established method for delivering metered quantities of oil or grease under pressure to a number of bearings as and when required. The system consists of a pump, incorporating an automatic change-over valve, connected through dual feed-lines to a number of metering feeder blocks connected in series. Lubricant pumped through one of the feed-lines passes through each block in turn, and in so doing causes a metered quantity of lubricant to be discharged to the appropriate bearing. When all feeder blocks have so functioned, a return flow to the change-over valve causes delivery to be diverted to the other feed-line, reversing the direction of flow through the system.

* * *

AT a conference held at the Waldorf Hotel, London, on 2 September, Xzit (G.B.) Ltd. introduced a number of their products to members of the Press. Demonstrations were given of the applications and methods of employment for a wide range of refractory materials for bonding, coating and patching; anti-corrosion coatings; fuel additives and solvents. The company, which is entirely British, manufactures its products under American patents, and is said to have a large export trade. Literature is available on request from the company, 175 Piccadilly, London, W.1.

* * *

HESS Products Ltd., 4 Albion Street, Leeds 1, announce the introduction of four new products. These are Distec A125, a white distilled fatty acid, being a mixture of predominantly C16 and C18 acids in the ratio of approximately 40:60, with an iodine value of 70-80; Distec A174 and A179, mixtures of C16 and C18 acids (40:60) with the unsaturated portion almost entirely monoethenoid, and iodine value 40-50; and HG271, hardened castor oil, the main acid constituent (85 per cent) being 12-hydroxystearic acid, together with some 15 per cent of stearic. Stearic acid A129 has been discontinued.

* * *

A NEW 12-page technical information bulletin on ethylene glycol has just been released by Carbide and Carbon Chemicals Company, a Division of Union Carbide and Carbon Corporation of New York. Physical properties, specifications, shipping data, constant boiling mixtures, physiological properties and uses are discussed. The bulletin has eight charts showing physical properties of interest to users of glycol.

Israeli Firm's Record

Superphosphates Soar

A RECORD production of 7,700 tons was reached in the superphosphate plant of the Fertilisers and Chemicals Company of Israel in June, and its productive capacity rose to 300 tons a day. The total output of superphosphates was 17,500 tons during the second quarter of 1954, compared with 5,100 tons in the corresponding quarter of 1953.

As a result of a process worked out by the company's chemists, the solubility of the superphosphate in water has been increased by 8 per cent, and it is thus expected that the product will command a higher price in the market.

The production of sulphuric acid jumped from a monthly average of 900 tons to 3,450 tons. Seventy per cent of the acid produced was used for superphosphate manufacture, and 3,000 tons were exported to Turkey and Cyprus during the three-month period April-June, 1954. The export of acid to Turkey was temporarily held up pending completion of repairs in the Turkish superphosphate plant.

The stock of pyrites residue now amounts to over 13,000 tons, and markets are being sought for this product.

The increased production of the Fertilisers and Chemicals Company has been coupled with new plants for further expansion. The equipment of the nitric acid plant is now awaiting release from customs at the Haifa port.

The Israeli Government has asked the company to start work on a rock phosphate calcination plant near the phosphate mines in the Negev. The process allows a considerable saving in sulphuric acid.

Finally, the share capital of the company has been raised from 1L.5,500,000 to IL. 6,500,000, and the newly issued common stock will be sold mainly to the Israeli Government in order to secure the latter 50 per cent of the voting power.

MR. ROBERT RAESIDE, of Cleadon, Sunderland, a retired director of the Washington Chemical Co., County Durham, has died at the age of 65. He joined the Washington Company 34 years ago and in 1930 was elected a director. Until his retirement five years ago he controlled the export business of the company.

Manchester Courses

TWELVE courses in specialised branches of chemistry are planned by the Manchester and District Advisory Council for Further Education, on the recommendation of the Post Advanced Chemistry Advisory Committee, for the 1954-55 session. Some of the courses are to be held in the evenings and will extend over a period of weeks; others will be at week-ends, and one will be a full-time course lasting for a week.

Titles of the courses are: 'Chromatography,' 'Statistical Analysis' and 'Design of Experiments I and II' (a series of three courses), 'Chemicals from Petroleum,' 'Design of Reactors for Continuous Processing in the Vapour Phase,' 'Some Metals of Recent Industrial Application,' 'Planning Experiments to Determine Best Operating Conditions,' 'Recent Advances in Organic Chemistry,' 'The Chemistry of Synthetic Dyestuffs,' 'Symposium on the Teaching of Analytical Chemistry' and 'Infra-red Spectroscopy as Applied to Organic Compounds.'

Full details are given in a handbook published by the advisory council. The handbook also gives particulars of post advanced courses in chemistry which form part of the normal provision at technical colleges in the area.

Air Pollution Conference

SIR Hugh Beaver, chairman of the Government committee on air pollution, will give an address next week at the biggest air pollution conference held in this country. The committee's report, it is hoped, will be published within a few months.

Nearly 500 delegates and members, representing local authorities, Government departments, the fuel and power industries, manufacturing interests, the railways and technical organisations will be present at the three-day conference, organised by the National Smoke Abatement Society, which is to be held at Scarborough from 22 September. The presidential address on 'The Coal Crisis—and the Society' will be given by Sir Ernest Smith, who is also chairman of the Industrial Coal Consumers' Council, and the Des Voeux Memorial lecture by Sir Edward Salisbury, Director of the Royal Botanic Gardens, Kew, on 'Air Pollution and Plant Life.' There will also be papers on the industrial uses of gas and electricity.

Law & Company News

New Registrations

G. H. Langley (Pharmacy) Ltd.

Private company. (537,530.) Capital £4,000. Manufacturing, analytical, consulting, pharmaceutical and general chemists, etc. Directors: Mrs. Ellen M. Langley and Mrs. Phyllis E. Wills and Wm. H. Davies.

Hailsham Chemists Ltd.

Private company. (537,532.) Capital £70,000. Consulting, analytical, manufacturing, pharmaceutical and general chemists, etc. Directors: Geo. Oxley (permanent) and Mrs. Phyllis E. Oxley, Sydney H. Frank (permanent) and Mrs. Minnie H. Frank. Reg. office: 21 Gildredge Road, Eastbourne.

R. O. Harris & Co. Ltd.

Private company. (537,472). Capital £1,000. Manufacturers of and dealers in thermoplastic and thermosetting plastic mouldings, compounds and natural and synthetic products of all kinds, etc. Subscribers: R. O. Harris, A. Waters. R. O. Harris is the first director. Sec., J. Smith. Reg. office: Craigs Court House, 25 Whitehall, S.W.1.

Gammatron Nucleonics Ltd.

Private company. (537,235.) Capital £100. Manufacturers and sellers of and dealers in radio-isotope equipment, instruments and apparatus, designers and engineers of electronic and nucleonic appliances, etc. Subscribers (each with one share) are: Sir James Marshall-Cornwall (Development) Ltd., and Primar Electronic & Technical Products Ltd. Directors: Sir James Marshall-Cornwall, K.C.B., O.B.E., D.S.O., M.C.; and Joseph Berman, M.D.

Safodik (Gt. Britain) Ltd.

Private company. (537,786.) Capital £5,000. Manufacturers of and dealers in soaps, soap powders, bleaching powders, etc. Directors: Albert W. Josephy and Harry A. Broughton. Reg. office: 35 Cockridge Street, Leeds.

John Connell & Company Proprietary Ltd.

Particulars filed 27 August 1954, pursuant to Section 407 of the Companies Act 1948. Capital: £300,000. Registered in Victoria, Australia in June 1954, to acquire the business carried on at 578 Bourke Street, Melbourne, as John Connell & Co. Ltd., and to carry on the business of exporters, importers and manufacturers of and dealers in foodstuffs, primary foods, drugs, chemicals, etc. British address: London House, Crutched Friars, E.C.3. Edwd. W. Baker of 52E Queen's Gardens, W.1., is authorised to accept service of process and notices. Directors: Ian O. Connell, Melbourne; John A. Kenny, Sydney, and Walter O. Burt, Melbourne.

Ansor Corporation

Particulars filed 6 September, 1954, pursuant to Section 407 of the Companies Act 1948. Capital $500,000. Registered in the United States of America on 12 September, 1949, to acquire and deal with goods, wares and merchandise and to carry on the business of factors, agents, commission merchants, preparers of and dealers in drugs, medicines, etc. British address: 7 Birchin Lane, London, E.C.3. Ernest G. Morley, 25 Thornbury Avenue, Isleworth, Mdx., is authorised to accept service of process and notices. Directors: Andres Soriano, Joseph H. Foley, Harry W. Colnery, Antonio S. Garcia, Otis F. Bryan, Niels Nyborg, Jose Maria Soriano, Andres Soriano, Jnr., Edwd. T. Bolton and Joseph H. Foley, Jnr., all resident in the USA, and Antonio M. Macleod, of Manila.

Company News

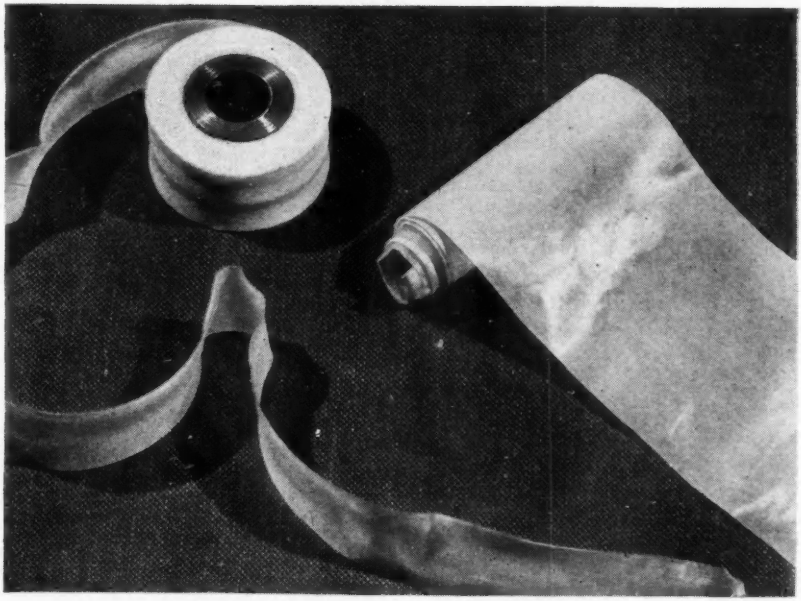
Monsanto Chemicals Ltd.

A first interim dividend of 6¾ per cent, the same as last year, was declared by the directors of Monsanto Chemicals Ltd. on 8 September. Net sales (unaudited) for the half year to 30 June were reported as £6,142,468, compared with £5,208,182 in the first half of 1953, and net income after tax was £408,179 against £223,665. Domestic sales have increased, and a satisfactory feature is that products appear to be going directly into consumption, not into stock. Export sales volume has been maintained despite anticipated intensification of foreign competition.

A. J. White Ltd.

Group profit of A. J. White Ltd. for the year ended 31 March was £195,771, compared with the previous year's figures of

[continued on page 594



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LONDON, S.W.1

P.573

Company News (contd.)

£216,281. Net assets, however, rose from £858,886 to £902,635, and the group profit after taxation of £85,859 is still more than enough to cover dividends three times over.

Pinchin, Johnson & Associates Ltd.

Substantial increases in the net profits of the parent company and the consolidated net profits of the group were reported at the annual general meeting of Pinchin, Johnson & Associates Ltd. on 8 September. The parent company's profits for the year ended 31 March were £1,144,327 compared with £872,719 for the previous year, while the consolidated net profits were £1,624,572 (£1,256,400), of which £929,546 was absorbed by tax. A total dividend of 25 per cent was approved.

Quickfit & Quartz Ltd.

Quickfit & Quartz Ltd., manufacturers of scientific glassware and interchangeable laboratory apparatus, of Stone, Staffs, made a profit last year of £18,531 before tax, it is revealed in the annual report to shareholders. The report recommended a dividend of 20 per cent—the first dividend that Quickfit & Quartz have paid on their ordinary shares. Previous profits have been 'ploughed back' to provide new equipment and to enlarge the works.

Albright & Wilson Ltd.

Provisional accounts of Albright & Wilson Ltd. for the half year to 30 June show that the combined trading profits of the group were £1,680,000, compared with £1,370,000 in the same period of 1953. Net profits were £430,000, against £375,000. The turnover of the group as a whole has increased substantially over that of the first half of 1953. In order to bring interim dividends more into line with the total distributions of recent years, the board is raising the payment in respect of 1954 to 7 per cent from the previously long unchanged rate of 5 per cent.

Next Week's Events

MONDAY 20 SEPTEMBER

Institute of Metal Finishing

London: Northampton Polytechnic, St. John Street, E.C.1, 6.15 p.m. Opening meeting, 'Surface Finishes by Vacuum Evaporation,' by F. C. Weil, Ph.D.

The British Ceramic Society

Stoke-on-Trent: North Staffordshire Technical College, 6.30 p.m. Annual general meeting, pottery section, 7 p.m. Annual general meeting of the society, 7.45 p.m. Presidential address by Mr. Richmond Douglas.

TUESDAY 21 SEPTEMBER

Society of Chemical Industry

London: Chemical Society's Rooms, Burlington House, Piccadilly, 6.30 p.m. Plastics and Polymer Group meeting, 'Vinyl Acetate and its Derivatives,' by Dr. O. Horn (Farbwerke Hoechst AG).

FRIDAY 24 SEPTEMBER

Institute of Metal Finishing

Sheffield: Grand Hotel (Fitzwilliam Room), 6.30 p.m. Sheffield and North East branch meeting, 'Barrel Polishing.'

Market Reports

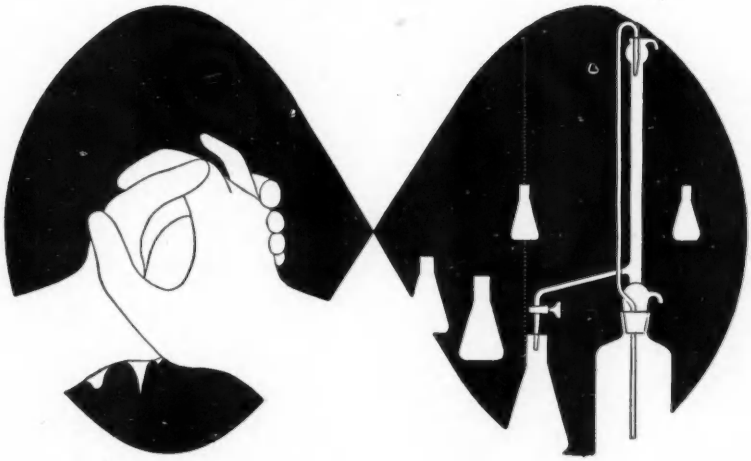
LONDON.—Both prices and conditions on the general chemicals market remain more or less unchanged. A fair amount of new business has been placed for the leading home consuming industries and contract deliveries are being called for in good quantities. There has been no contraction in overseas demand, a good volume of export inquiry being in evidence, chiefly for Commonwealth destinations. In the coal tar products market the movement continues to be steady with prices showing a firm undertone.

MANCHESTER.—Heavy chemical products have maintained a generally steady price front on the Manchester market during the past week and little sign of easiness is in evidence in any direction. Most industrial users in Lancashire, including the chemical and allied trades, are specifying for good deliveries against existing commitments and new bookings in the aggregate have been on a fair scale. A fair number of shippers' inquiries are also circulating. Fresh business in fertilisers has been moderate. A steady demand for most of the light and heavy tar products has again been reported.

GLASGOW.—The upsurge experienced last week in practically all branches of the industry has again been maintained, and an extremely busy week is reported from manufacturers and merchants alike. Prices, with few exceptions, have remained firm and considerable activity has again been shown with regard to materials for export.

The common test of tincture of soap

" Dr. Clark then exhibited his method of ascertaining quantitatively the comparative hardness of water by means of the common test of tincture of soap, illustrated by experimental evidence, to prove the accuracy of which it is susceptible and the facility of its application."



Dr. Clark gave his demonstration at one of the first meetings of the newly formed Chemical Society in 1841, and the above is an abstract from Volume I of the Proceedings.

The B.D.H. catalogue still includes Clark's Soap Solution and testifies to the remarkable permanence of his technique. Greater accuracy and convenience in total hardness determination, however, are now obtained from the B.D.H. Hardness Solutions and Indicator based on the use of ethylenediamine-tetracetic acid as advocated by Schwarzenbach and others.

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MILD STEEL SILEX LINED PEBBLE MILL by Boulton, 6 ft. by 6 ft. mounted on trunnion bearings, and driven through gearing and Wigglesworth clutch by 25 h.p. Crompton Parkinson motor, 415/3/50. Complete with grinding media.
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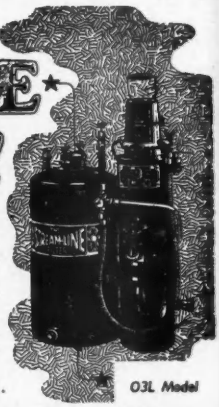

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